

Emerging Topics in Pediatric Echocardiography: A Review by the Associate Editors of the Pediatric Section

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In this review, we selected five recently published studies addressing structural, functional, and methodological aspects of echocardiographic assessment in pediatrics (Table 1). The studies provide new perspectives on the embryological basis of ventricular septation, the quality and applicability of echocardiographic nomograms, the accuracy of right ventricular (RV) diastolic function assessment, and the use of RV and left ventricular (LV) strain as early markers of dysfunction. The objective of this review is to offer readers of *ABC Imagem Cardiovascular* a critical synthesis of emerging topics with potential applicability in both clinical practice and research in pediatric echocardiography.

We wish all readers an engaging and informative reading experience.

Ventricular septal morphology and cardiac development

Anderson et al.¹ convened international experts to propose a unified morphofunctional classification of ventricular septal defects, with emphasis on embryological features and ventriculoarterial connections. The authors critically examine the nomenclature currently in use and suggest that defect descriptions should encompass both their anatomical location and the borders involved. This approach integrates principles of cardiac development and allows, for example, differentiation between perimembranous defects in hearts with double outlet right ventricle and those with concordant ventriculoarterial connections. The article provides a clear and didactic review of cardiac embryological development, supported by illustrations that facilitate a more precise diagnostic and surgical approach.

Echocardiographic nomograms: advances and gaps

In their review, Cantinotti et al.² critically analyze approximately 2 decades of scientific production related

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to nomograms in pediatric echocardiography. The study highlights important advances, including greater methodological robustness, larger sample sizes, improved standardization, and the use of more rigorous statistical models. Nevertheless, significant limitations persist, such as underrepresentation of diverse ethnic groups, limited data in preterm infants and low-birth-weight neonates, and inconsistencies in the normalization of diastolic parameters. The authors also advocate for the integration of nomograms into echocardiographic reporting systems and emphasize the need for further studies with greater population diversity and multicenter validation of emerging metrics, including strain and three-dimensional volumes.

Assessment of RV diastolic function: technical challenges and innovative approaches

Henry and Mertens³ address the current state of RV diastolic function assessment, an area that has traditionally received less attention than LV evaluation. The article highlights the limitations of conventional parameters, such as the tricuspid E/A ratio and e' velocity, particularly in children, in whom age-related variability, heart rate, and hemodynamic loading conditions are substantial. As alternative approaches, the authors propose the use of right atrial reservoir strain and RV global longitudinal strain (RVGLS). In addition, emerging techniques are discussed, including ultrafast ultrasound imaging, with potential applications in assessing intraventricular pressure gradients and shear wave velocity for the analysis of myocardial stiffness. These methods are described as promising, although they remain largely experimental.

RV maturation in preterm infants with pulmonary disease

Within the context of RV functional assessment, Sawamura et al.⁴ conducted a longitudinal study to evaluate the maturation of RV function in preterm infants during the first year of life. The results demonstrated that the presence of bronchopulmonary dysplasia impairs the expected trajectory of cardiac maturation, an effect detectable through RV strain analysis. The study also identified a significant impact of mechanical ventilation strategies on long-term cardiac function. High-frequency oscillatory ventilation was associated with better RVGLS performance at 1 year of age, whereas prolonged invasive ventilation and oxygen dependency were predictors of poorer ventricular function. These findings suggest that ventilatory strategies may directly influence cardiac maturation in this population.

Table 1 – Recently published studies addressing structural, functional, and methodological aspects of pediatric echocardiographic assessment

Study ID	Reference	Study summary
1	Anderson et al., 2025 ¹	Proposal of a unified morphofunctional nomenclature for ventricular septal defects, grounded in embryological development, with direct implications for diagnosis and surgical planning.
2	Cantinotti et al., 2025 ²	Review of advances in pediatric echocardiographic nomograms, highlighting methodological improvements while emphasizing limitations related to ethnic diversity and representation across different age groups.
3	Henry e Mertens, 2025 ³	Critical analysis of current limitations in assessing RV diastolic function in children, with the proposal of emerging methods, including ultrafast ultrasound imaging and strain parameters.
4	Sawamura et al., 2025 ⁴	Longitudinal study in preterm infants demonstrating an association between bronchopulmonary dysplasia and reduced RV functional gain, and identifying a positive impact of high-frequency oscillatory ventilation on RVGLS.
5	Melo et al., 2024 ⁵	Study evaluating pre-CPB LVGLS by transesophageal echocardiography, demonstrating prognostic associations with mortality and postoperative complications.

CPB: cardiopulmonary bypass; LVGLS: left ventricular global longitudinal strain; RV: right ventricle; RVGLS: right ventricular global longitudinal strain.

LV global longitudinal strain (LVGLS) in pediatric cardiac surgery

Melo et al.⁵ evaluated the association between LVGLS, measured by transesophageal echocardiography, and postoperative outcomes in children undergoing congenital cardiac surgery with cardiopulmonary bypass (CPB). LVGLS proved to be a feasible, reproducible measure for assessing ventricular function. Both pre-CPB and post-CPB

values demonstrated effective discriminatory capacity for predicting 30-day mortality, with pre-CPB LVGLS showing the greatest predictive power. Pre-CPB LVGLS values $\leq -12\%$ were significantly associated with higher vasoactive-inotropic scores and longer durations of mechanical ventilation. The authors suggest that LVGLS may represent a relevant prognostic tool for predicting mortality and postoperative complications in this population.

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